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ABSTRACT

This course guide for a power technology course is one of four developed for the energy/power area in the North Dakota senior high industrial arts education program. (Eight other guides are available for two other areas of Industrial Arts--graphic communications and production.) Part 1 provides such introductory information as a definition and instructional objectives for Industrial Arts. Part 2 contains the course rationale and objectives; guidelines for implementation; taxonometric structure; course description including length, credit, prerequisites, and student competencies; suggested instructional units with required number of class periods; and nine units. Each unit includes some or all of the following material: unit objective(s), topic outline, and selected student competencies to be developed through sample coordinated learning activities. Unit titles are Introduction to Power Technology; Basic Power Technology Concepts; Machines; Conversion of Power: Heat Engines; Electrical Conversion of Power; Mechanical Transmission of Power; Fluid Power; Research and Development; and Careers in Power Technology. A reference list is appended. (YLB)

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NORTH DAKOTA SENIOR HIGH
INDUSTRIAL ARTS
CURRICULUM GUIDES

POWER TECHNOLOGY

(ENERGY / POWER)

INDUSTRIAL ARTS
SENIOR HIGH--LEVEL II

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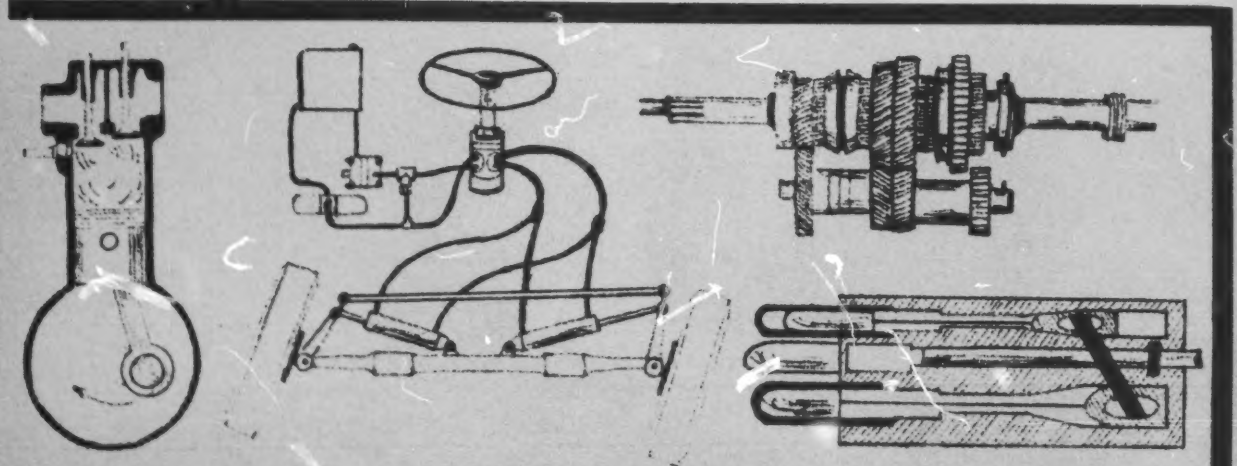

NORTH DAKOTA

ED030557

NORTH DAKOTA STATE BOARD FOR
VOCATIONAL EDUCATION
Bismarck, North Dakota

NORTH DAKOTA SENIOR HIGH INDUSTRIAL ARTS CURRICULUM GUIDES

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PREFACE

One of the biggest challenges facing education today is keeping the instructional content current. Industrial Arts in particular must be quick to respond to changes in our technological society. For many years, North Dakota has offered quality industrial arts programs to students in the public schools. Credit for this is due to the teachers who have shown the desire to continually improve programs, keep their content current, and make instruction relevant.

The Industrial Arts curriculum has boundless potential for courses and program development. However, this program possibility excites the imagination of teachers to offer endless number of courses which causes a need to determine what is of greatest value for students to experience.

Thus, the development of an appropriate or model curriculum requires a critical examination of several undergirding questions: What is the overall responsibility of Industrial Arts? What Industrial Arts goals are appropriate for the different grades or school levels? What courses constitute a meaningful curriculum for these goals to be realized? What shall be the scope and sequence of the total curriculum? The answers to these questions have been addressed by a North Dakota Industrial Arts Master Plan curriculum committee and are recorded in the North Dakota Senior High Industrial Arts Program of Studies booklet.

The Program of Studies describes the complete secondary school industrial arts education. The Program of Studies Booklet emphasizes the Level II Senior High programs with specific courses, course descriptions, objectives and units of instruction. The Junior High-Level I program is dealt with in a general basis for the purpose of articulating the two levels within the total secondary school industrial arts program.

Three types of Industrial Arts programs are included in the Program of Studies along with the individual courses which constitute the complete secondary school curriculum:

1. ORIENTATION AND EXPLORATION-- Level I program designed for grades seven through nine. The purpose of this program is to provide students with first-hand exploratory experiences in the four technical cluster areas. The learning experiences should provide an awareness of the impact of industry and it's associated technologies on the lives of individuals. Furthermore, this program assists individuals in making informed and meaningful occupational/career choices.
2. PERSONAL ENRICHMENT-- The program designed to prepare students with a general education of technolgical literacy, avocational skills and consumer information. This is purely an elective program of students for students who desire to gain an understanding of the technical concepts for personal satisfaction.
3. PRE-TECHNICAL-- This program provides concentrated and specialized technical courses for grades ten through twelve. These courses are articulated with the Level I technical cluster areas. Students at this level have a wide range of interests, abilities, and life aspirations. Therefore, the key element for the senior high pre-technical program is flexibility to meet the varied needs of learners. The program is designed to prepare students for advanced educational or training programs.

The North Dakota Senior High Program of Studies identified twelve different courses recommended to be offered in grades ten, eleven and twelve. The model curriculum lists four courses for each of three technical areas: (1) Energy/power,(2) Graphic Communications, and (3) Production. Individual course guides have been developed for each of the twelve courses recommended for the senior high curriculum. This being one of the twelve course guides. Similar guides have been developed for the remaining eleven.

Each course guide contains the course rationale, objectives,content, units and selected student competencies to be developed along with student learning activities. The primary aim of the course guides is to provide meaningful direction and still leave opportunity for individual teacher creative approaches in meeting the diverse needs of unique school populations. The course guides not only proposes to assist teachers and administrators in keeping their programs up-to-date, but also to promote industrial arts education program uniformity among North Dakota schools.

Ernest Breznay

Ernest Breznay
State Industrial Arts Supervisor
North Dakota State Board for Vocational Education
July, 1981

ACKNOWLEDGEMENTS

The North Dakota Industrial Arts profession is indebted to the following individuals who gave their time and talents in the development of the Twelve Senior High Industrial Arts course guides. These teachers and teacher educators attended an Organizational meeting, participated in a curriculum writing seminar, and developed individual course guides during 1980 & 1981.

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BASIC BELIEFS ABOUT INDUSTRIAL ARTS

INDUSTRIAL ARTS IS .....

- *an educational discipline founded upon the knowledge base of technology - the means by which material things are produced.
- *an instructional program affording boundless opportunities for learning how technology has been, is now and will be basic to human desires and needs.
- *a fundamental educational program that can serve educational priorities, whether they are academic education, general education, vocational education, career education, ad. inf.
- *an activity based curriculum enabling students to learn through doing.
- *logically a discipline with a curriculum continuum from grade K through 12.

INDUSTRIAL ARTS IS JUSTIFIED BECAUSE .....

- *all persons need to know about the technological environment, the material culture, and industry because they are economically, socially and emotionally affected by them.
- *all persons must make a career choice from an extremely large and increasing number of occupations that are affected by technology; therefore, they should have opportunities to develop interests, uncover talents, explore technical and applied science fields and study occupations.
- *all persons must select, buy, use, and maintain the products of industry -- houses, automobiles, appliances, clothes, furniture and items of a never ending list. A knowledge of products, their manufacture, characteristics, advantages and disadvantages makes for intelligent consumption.
- *all persons need recreational, leisure time and avocational outlets.
- *all persons need to have opportunities to develop planning, creative, problem solving and technical skills in harmony with their inherent desire to seek the better way.

INDUSTRIAL ARTS CAN HELP THE STUDENT TO .....

- *gain an understanding of industry and technology.
- *discover interests and talents.
- *develop techniques in problem solving.
- *develop basic skills in the safe use of tools and machines.
- *make informed and meaningful occupational choices.
- *acquire interests in avocational pursuits and hobbies.
- *develop safe working habits.
- *apply other school subjects.
- *become a wiser consumer.
- *develop creativity.
- *develop pride in work well done.
- *work cooperatively with others.

THE INDUSTRIAL ARTS MISSION

The mission of Industrial Arts Education is to assist the student in developing an understanding about industry and technology and in the discovery and development of individual potential.

GOALS

Consistent with their abilities, interests and educational needs:

1. Industrial Arts students at the middle or junior high school level will be aware of employment and/or self-employment opportunities and requirements for use in making career choices and in determining their educational programs.
2. Industrial Arts students at the senior high school level will acquire technical competencies in preparation for advanced vocational or technical education programs.
3. Industrial Arts students at the senior high school level will acquire competencies that lead to responsible citizenship through technological understanding, consumer knowledge and the productive use of leisure time.

INDUSTRIAL ARTS: AN OFFICIAL DEFINITION

Industrial Arts education programs means those education programs which pertain to the body of related subject matter, or related courses, organized for the development of understanding about the technical, consumer, occupational, recreational, organizational, managerial, social, historical, and cultural aspects of industry and technology including learning experiences involving activities such as experimenting, designing, constructing, evaluating, and using tools, machines, materials, and processes which provide opportunities for creativity and problem solving or assist individuals in the making of informed and meaningful occupational choices or which prepare them for entry into advanced trade and industrial or technical education programs.

INDUSTRIAL ARTS INSTRUCTIONAL OBJECTIVES

Industrial Arts students at the Senior High School Level will acquire competencies that lead to responsible citizenship through technological understanding, consumer knowledge and the productive use of leisure time. The program stresses the following instructional objectives:

1. Develop an insight and understanding of industry and technology, its place in our society and the free enterprise system.
2. Discover and develop individual talents, aptitudes, interests, and potentials as related to industry and technology.
3. Develop an understanding of industrial processes and the practical application of scientific principles.
4. Develop technical problem-solving and creative abilities involving the use of materials, processes, and products of industry and technology.
5. Develop an understanding of industrial and technological career opportunities and their requirements and develop those traits which will help students obtain and maintain employment.

As determined by Title II of PL No. 94-482, the Vocational Education Act of 1976 and the State Board for Vocational Education, the purpose of funding industrial arts programs with vocational monies will be to:

1. Assist individuals in the making of informed and meaningful occupational and educational choices.
2. Prepare individuals for enrollment in advanced or highly skilled vocational and technical programs.

NORTH DAKOTA INDUSTRIAL ARTS CURRICULUM

Program Scope and Sequence Model

ELEMENTARY LEVEL
(k-6)
Awareness

At the elementary level, learning experiences in industrial arts will be directed primarily toward the child's development of an awareness of industry/technology and the world of work. The concepts and activities will be integrated with the elementary curriculum to enrich and reinforce the common learning areas.

JUNIOR HIGH LEVEL I
(7-9)
Orientation and Exploration

INSIGHTS INTO INDUSTRY & TECHNOLOGY

A broad overview of industry and technology. Learning experiences will be directed toward the student's exploration of the historical, present, and future potentials of industry and technology.

SENIOR HIGH LEVEL II
(10-12)
Personal Enrichment
Pre-Technical

- **GRAPHIC COMMUNICATIONS TECHNOLOGY**
  - DESIGN/DRAFTING
  - PHOTOGRAPHY
  - GRAPHIC ARTS
  - CONSTRUCTION DRAFTING
  - INDIVIDUAL TECHNICAL PROBLEMS
- **MANUFACTURING TECHNOLOGY**
- **CONSTRUCTION TECHNOLOGY**

  PRODUCTION
  - WOOD TECHNOLOGY
  - PLASTIC TECHNOLOGY
  - METAL TECHNOLOGY
  - INDUSTRIAL CRAFTS
  - INDIVIDUAL TECHNICAL PROBLEMS
- **ENERGY/POWER TECHNOLOGY**
  - ENERGY SOURCES
  - POWER TECHNOLOGY
  - ELECTRICAL / ELECTRONIC TECHNOLOGY
  - TRANSPORTATION TECHNOLOGY
  - INDIVIDUAL TECHNICAL PROBLEMS

THE INDUSTRIAL ARTS PROGRAM OF STUDIES

LEVEL	GOAL	PROGRAM
II HIGH SCHOOL (Grades 10, 11, & 12)	1. Personal Enrichment 2. Pre-Technical	GRAPHIC COMMUNICATIONS TECHNOLOGY •Design/Drafting •Photography •Graphic Arts •Construction Drafting •Industrial Technical Problems ENERGY/POWER TECHNOLOGY •Energy Sources •Power Technology •Electrical/Electronic Technology •Transportation Technology •Individual Technical Problems PRODUCTION TECHNOLOGY •Wood Technology •Metal Technology •Plastic Technology •Industrial Crafts •Individual Technical Problems INDIVIDUAL TECHNICAL PROBLEMS (Multiple Offerings)
I JUNIOR HIGH SCHOOL (Grades 7, 8, &9)	1. Orientation 2. Exploration	•Insights into Industry and Technology •Graphic Communications Technology •Manufacturing Technology •Construction Technology •Energy/Power Technology

PROGRAM STANDARDS FOR INDUSTRIAL ARTS

ELEMENTS OF QUALITY INDUSTRIAL ARTS PROGRAMS

The success and quality of programs in industrial arts education depends upon elements that influence the quality of programs. Industrial arts must be responsive to the following elements:

A. GOALS AND OBJECTIVES: Program goals and objectives are established that provide the inspiration and guidance in program development, operation and evaluation.

B. INSTRUCTIONAL STAFF: The instructional staff is competent and meet necessary qualifications.

C. INSTRUCTIONAL PLAN: Selected subject matter is appropriate to learner's level and consistent with curriculum and course goals and objectives.

D. STUDENT ORGANIZATIONS: The establishment and operation of effective student organizations.

E. FACILITIES AND EQUIPMENT: Instructional facilities are well-designed, located and supportive of accomplishing curricular goals. (Refer to Educational Specifications for Industrial Arts Instructional Facilities Handbook, 1978.)

F. SPECIAL NEEDS: The program must provide for disadvantaged and handicapped students.

G. ADVISORY COMMITTEES: The establishment and effective use of industrial arts advisory committees.

H. GUIDANCE: The teacher's role in guidance.

I. ADMINISTRATION: Administration of the industrial arts program.

J. EVALUATION: Evaluation procedures are planned and implemented to assure continual program improvement.

NOTE: For further information on program standards, refer to the NORTH DAKOTA VOCATIONAL/TECHNICAL EDUCATION PROGRAM STANDARDS, Section 11.1 to 11.7.

INDUSTRIAL ARTS COURSE CODE NUMBERS
(Vocationally Funded)

Insights Into Industry and Technology	10001
Construction Technology	10011
Manufacturing Technology	10021
Wood Technology	10023
Metal Technology	10026
Plastic Technology	10029
Energy and Power Technology	10031
Electrical/Electronic Technology	10033
Energy Sources	10038
Power Technology	10039
Graphic Communications Technology	10051
Graphic Arts	10052
Design/Drafting	10053
Photography	10054
Construction Drafting	10056
Transportation	10061
Industrial Crafts	10080
Individual Technical Problems	10091
Individual Technical Problems	10092

PART II:

POWER TECHNOLOGY COURSE GUIDE

(# 10039)

POWER TECHNOLOGY

Rationale:

The purpose of studies in the energy/power area is to develop a realization, through activity-oriented instruction, that energy availability, conversion, efficient usage, conservation, and futuristic concerns are essential to life. Studies about energy/power involve classroom and hands-on activities. These studies should prepare the student to consider the socioeconomic and environment impacts and the occupational aspects of the energy-power field.

A course in power technology is important for several reasons. Power technology provides the prime mover - the inputs, conversions, transmissions, and controls - for production, transportation, communications, and virtually all other industrial activities in our culture. Power technology uses energy to provide it's outputs, and therefore, students should study power technology so they can become efficient users of energy and wise users of their technology. A course in power technology is also important because students should become aware of possible problems, areas needing research, development, career choices and opportunities relating to modern technology.

Course Objectives:

(1) To develop an understanding and awareness of career opportunities and the impact of power technology in today's society.

(2) To develop an understanding of the methods and processes used in transmission and/or conversion of power.

(3) To develop through problem solving and application, an awareness of power technology, and to provide needed technical competencies.

(4) To help the student determine the significance of power systems in our society, and to emphasize manufactured and harvested goods, services, and other necessities provided by the power technology industry.

Guidelines For Implementation

Success in the classroom or laboratory depends on many factors. Foremost among these is the planning effort on the part of the teacher. Educational programs must be flexible and adaptable. They must be flexible enough to remain adaptable to all locales, in numerous types of facilities, and with students possessing differing values and interest. Therefore, a successful program must be capable of application in both small and large schools.

The industrial arts program recommended by these course guides are designed to meet individual student needs. They provide teachers with guidelines for a well balanced program with suggested teacher options in each of the three major technical study areas: (1) Graphic Communications; (2) Energy/Power; and (3) Production. The North Dakota secondary school industrial arts program suggests three levels of learning with an alternative curriculum approach at the Level II for those schools that cannot offer specific courses identified for each of the three technical study areas due to the size of enrollments or other limiting factors.

The recommended scope and sequence of course offerings for the energy/power technical study area is illustrated on the sample program model on page 13. The Level I Energy/Power Technology course serves as an orientation and exploration experience. It is recommended as a prerequisite to the four Level II courses. The senior high Level II courses provide concentrated and indepth exploratory experiences in four study areas related to energy/power: (1) Energy Sources; (2) Power Technology; (3) Electrical/Electronic Technology; and (4) Transportation Technology. Since students at the senior high level display a wide range of interest, abilities, and life goals, the industrial arts program must provide a variety of learning experiences and course options to meet individual student needs, it is recommended that the specific course options be made available to students when possible. For the smaller mid-sized schools, it may not be feasible to offer all four of the specific courses identified for Level II. If that should be the case, it is recommended that one or two of the courses be offered and supplemented by an ITP (Individual Technical Problems) course as a Level II alternative. (See ITP Course specifications on page 14.) This course is designed to provide multiple learning experiences in the technical area of energy/power to meet individual needs of students.

The Level III ITP specialized course (Code #10092) is suggested for students in larger programs who have had the Level II indepth exploratory courses in energy/power and desire to study a specialized aspect related to any phase of energy/power technology. The student may select a technical problem in such areas as alternate energy sources, energy conversion, transmission, and others. (See pages 15 and 16 for the specific ITP specialized course specifications and technical problem options).

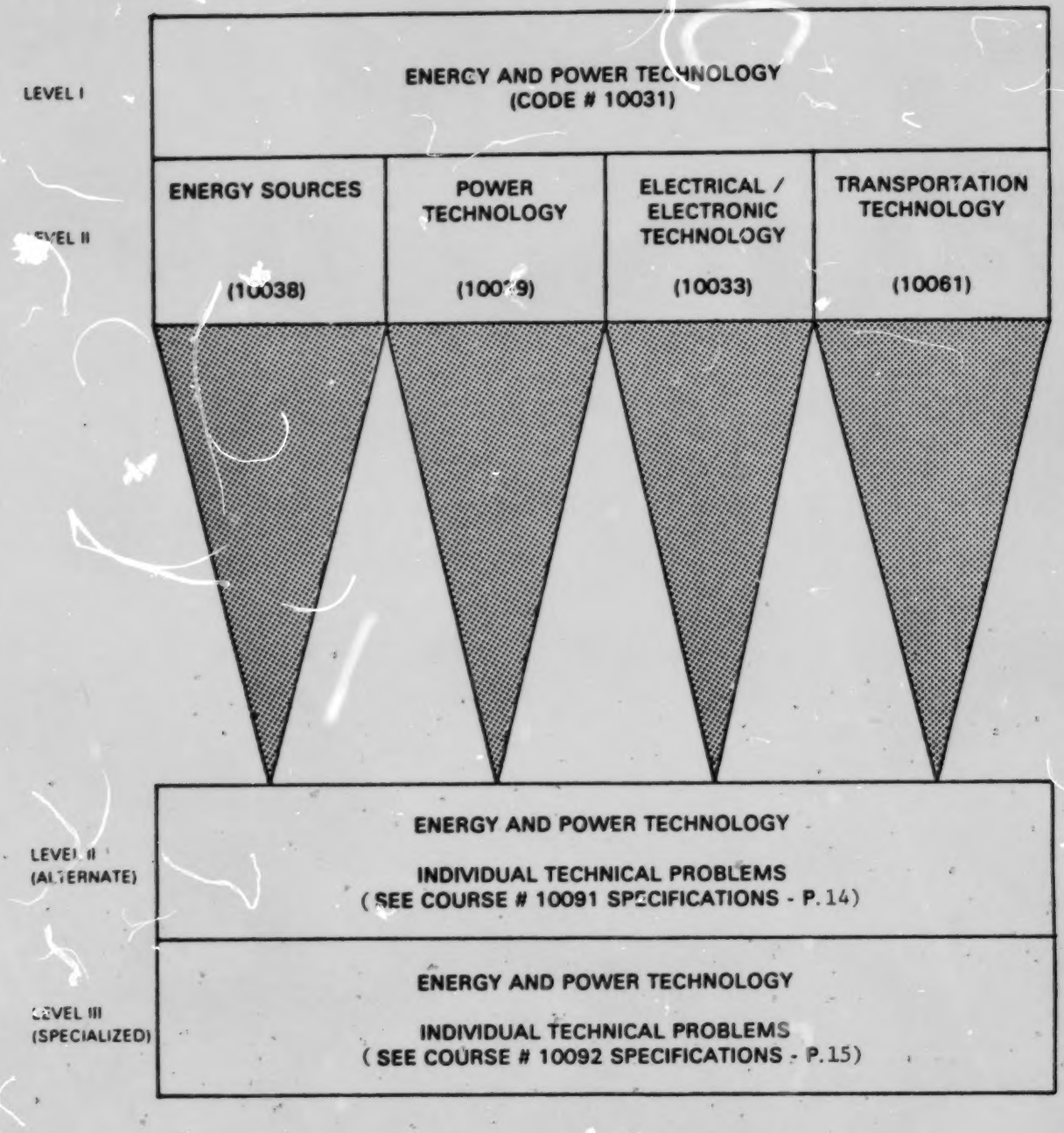
Guidelines For Implementing the Power Technology Course

The body of knowledge has been organized so that the instructor may follow the course exactly or may expand, delete, or modify the content used. The activities which the instructor chooses from this guide are not intended to be used exclusively. Rather, they are intended to be suggestive, or used to reinforce the text and/or lecture material.

Additional ideas may be found in texts listed in the Reference section. Some ideas and activities may become obsolete and the instructor should update these periodically.

The implementation of a power technology course does not necessarily require vast amounts of expensive technical equipment. The guide, and particularly the suggested activities, if properly used, should assist the teacher in providing an economical power technology course.

It should be noted that it will probably be most efficient for the instructor to organize some laboratory activities related to units V, VI, and VII according to the following approach. Rather than having one motor, transmission, differential, hydraulic pump, etc., for each student (constituting many of each type), locate one or two or each item at work station throughout the laboratory and rotate the entire group of students through. Allow each student a sufficient period of time to complete the required activities. This should prove satisfactory to both the student and the instructor.



Sample Program Model

INDIVIDUAL TECHNICAL PROBLEMS

COURSE CODE: 10091

This individual technical problem course is designed for students who have not had the opportunity to enroll in specific Level II subject matter courses in the Energy/Power Technology cluster area. The course is designed to provide a means for meeting individual student needs through the offering of multiple activities in a number of technical areas in schools where separate courses are not available.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

11 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

Level I Curriculum Courses

SELECTED STUDENT COMPETENCIES

NOTE: Individual student competencies and learning experiences are to be identified and developed on a contractual basis by the student and approved by the instructor for each problem.

SAMPLE LEARNING TOPICS

NOTE: Learning topics for the ITP are to be selected from the instructional units identified for each specific subject matter course. These courses include:

ENERGY/POWER:

- Energy Sources, 10038
- Power Technology, 10039
- Electrical/Electronic Technology, 10033
- Transportation Technology, 10061

INDIVIDUAL TECHNICAL PROBLEMS: ENERGY/POWER

COURSE CODE 10092

This individual technical problems course is designed for students who have had the Level II preliminary course of this cluster in the chosen area of study and intend to study specific advanced topic(s) in energy sources, power technology, electrical/electronic technology and/or transportation technology.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

11 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

See Course Description

SELECTED STUDENT COMPETENCIES

Instruction in this industrial arts course is open to meet students needs. The following suggested objectives are meant to provide ideas for developing the student's program.

1. To prepare students for seeking advanced education in the area of energy/power.
2. To provide students the experiences in problem-solving, research and development, and technical report writing with regard to any chosen topic in energy/power.
3. To provide students with opportunities for exploration in energy/power systems and the practical application of scientific principles related to these systems.
4. To provide students with a broader understanding of career opportunities in energy/power.

10092
COURSE CODE

INDIVIDUAL TECHNICAL PROBLEMS:

ENERGY/POWER

SAMPLE LEARNING UNITS

ENERGY SOURCES:

I. Gasahol Production
II. Solar Heating and/or Cooling
III. Solar Photovoltaic Banks
IV. Wind or Water Energy Conversion Systems
V. Energy Storage Systems

POWER TECHNOLOGY:

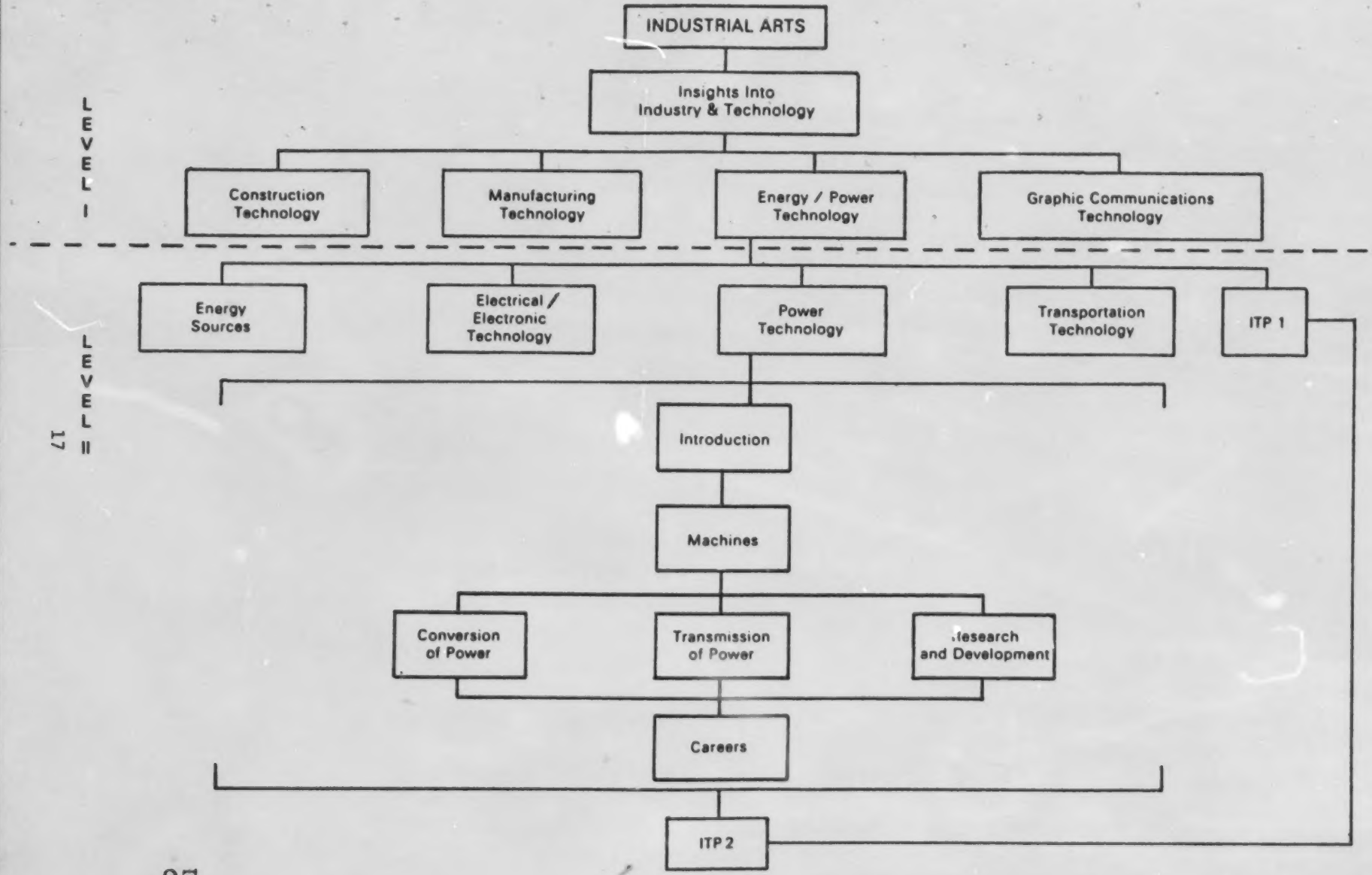
I. Stirling Engine/Heat Pump
II. Steam Engine
III. Dynomometers for System Analysis
IV. Hydraulic/Pneumatic Controls

ELECTRICAL/ELECTRONIC TECHNOLOGY:

I. Amateur Radio
II. Alarm Systems
III. Trouble Shooting Communications Equipment
IV. Vehicular and Other Microprocessor Control Units

TRANSPORTATION TECHNOLOGY:

I. Electrical Vehicle Propulsion
II. Linear Induction Motor Propulsion
III. Air Suspension Systems


INDUSTRIAL ARTS
Insights Into Industry & Technology
LEVEL I
Construction Technology
Manufacturing Technology
Energy / Power Technology
Graphic Communications Technology
LEVEL II
Energy Sources
Electrical / Electronic Technology
Power Technology
Transportation Technology
ITP 1
Introduction
Machines
Conversion of Power
Transmission of Power
Research and Development
Careers
ITP 2

POWER TECHNOLOGY

COURSE CODE 10039

This course is designed to provide students with the necessary information and techniques so they may apply or understand the conversion or transmission of traditional power sources, along with the various types of power of the future. Career opportunities will also be explored.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

None

SELECTED STUDENT COMPETENCIES

Experiences and activities of this industrial arts course should enable the student to:

1. Determine some of the economic and social effects which power technology has on society.
2. Evaluate the methods and processes used by industry to transmit or convert energy.
3. Discuss the development of thermal, mechanical and fluid power.
4. Exhibit safe practices in working with power systems, tools, and equipment.
5. Critically discuss the principles of various internal and external combustion engines or power plants.
6. Design, plan and/or modify a small power product.
7. Critically discuss the application of mechanical systems.
8. Analyze through experimental procedures various power systems.
9. Identify and select appropriate power systems for practical applications.

10039
Course Code

POWER TECHNOLOGY

Suggested Instructional Units

	Class Periods (18 wks)	(36 wks)
I. Introducing Power Technology	5	5
II. Basic Power Technology Concepts	5	5
III. Machines	5	10
IV. Conversion of Power: Heat Engines	20	50
V. Electrical Conversion of Power	10	20
VI. Mechanical Transmission of Power	10	30
VII. Fluid Power	10	15
VIII. Research and Development	20	40
IX. Careers in Power Technology	5	5
TOTAL	90	180

UNIT I

Introduction to Power Technology

OBJECTIVES:

This unit is meant to provide the student with:

1. A broad overview and general introduction to the course, power technology.
2. Information about power technology, safety and tools.
3. A historical perspective of power technology and information about its significance in our culture.

1.0.0 What is Power Technology?

- 1.1.0 Machines
- 1.2.0 Mechanical transmission of power
- 1.3.0 Heat engine conversion of power
- 1.4.0 Electrical conversion of power
- 1.5.0 Research and development
- 1.6.0 Power technology careers

2.0.0 The Significance of Power Technology

- 2.1.0 Our everyday lives
  - 2.1.1 Moving from place to place
  - 2.1.2 Accomplishing tasks
- 2.2.0 What powers industry?
- 2.3.0 Transporting and producing goods
- 2.4.0 Communicating
- 2.5.0 Simple recreation

3.0.0 Power Technology in History

- 3.1.0 Wheel
- 3.2.0 Crude tools

3.3.0 Fire

3.4.0 Carriage/wagon

3.5.0 Wind power/sailing

3.6.0 Bicycle

3.7.0 Electricity

3.7.1 Motors and generators

3.8.0 Heat engines

3.8.1 Steam, diesel, spark-ignition, internal combustion and others

4.0.0 Power Technology Safety

4.1.0 A question of attitude

4.1.1 Good organization, conservative movements, cooperation, courtesy and no horseplay!
4.1.2 Safety zones, lines and areas
4.1.3 Safety guards - use them!

4.1.3.1 Eye and face protection
4.1.3.2 Finger and foot guards
4.1.3.3 Aprons, gloves, leg guards

4.1.4 Common injuries

4.1.4.1 Burns, cuts, eye injuries, pinches, clothing caught in moving parts, poor ventilation.

4.1.5 Common Hazards

4.1.5.1 Hot objects, intense light, flying materials/debris, mechanical failures, electrical

4.1.6 Fires

4.1.6.1 Small fires, flammable liquids, electrical intense fires - know where the extinquishers are.

4.1.7 First aid

4.1.7.1 Breathing, bleeding, burns, shock

5.0.0 Problems Related to Power Technology

- 5.1.0 Where will the resources come from?
  - 5.1.1 Fuels, metals, etc.
- 5.2.0 Can we afford power technology in the future?
- 5.3.0 Environmental concerns
- 5.4.0 Research and development needed
  - 5.4.1 Electric vehicles, wind power, solar power

6.0.0 Tools Used in Power Technology

- 6.1.0 Vise, hammer, punches, chisels, screwdrivers, pliers, wrenches, files, saws, drills, grinders, presses, measuring tools, others...

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT I: Introduction to Power Technology

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Define power technology.	A-F Use library reports, teacher lectures, group discussions, films, industrial tours, guest speakers, examinations, textbooks, student presentations.
	A.1 Design and construct a scale model of a current power technology system.
	A.2 Locate numerous selected magazine or newspaper reports relevant to the topics under study - use these for discussions, presentations, etc.
	A.3 Locate technical literature (specifications, illustrations, service procedures, etc.) About a type of power technology (e.g., generator, motor, engine, machines in general etc.) and compare it to similar power technology.
	A.4 Visit a museum related to power technology.
B. Define and list a selected number of power technology developments in history.	B.1 Design and construct a scale model of a current power technology system.

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT I: Introduction to Power Technology

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
	B.2 Locate numerous selected magazines or newspaper reports relevant to the topics under study - use these for discussion, presentations, etc.
	B.3 Visit a museum related to power technology.
C. List and define a selected number of power technology developments in history.	C.1 Working in groups or individually, design and construct a model of a historical power technology device.
List the historical development and lineage for a power technology item, eg., motor, engine, power plant, battery, etc.	C-2 Have students make charts showing the lineage and development of a given power technology device.
	C.3 Visit a museum related to power technology.
D. List selected power technology safety concerns, or rules.	D.1 Have students identify possible power technology safety hazards, or problems related to the lab, their home, community, or a specific device. After identifying, each student should analyze the situation and provide an appropriate number of solutions.
Define why it is important to observe safety rules when dealing with power technology.	
List and describe a selected number of common injuries, hazards and safety guards.	

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT I: Introduction to Power Technology

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
Describe how attitude plays an important role in safety.	D.2 Have students identify unsafe circumstances or situations in newspapers or magazines and present ways to solve the problems.
Identify and describe a selected numbers of ways people involved with power technology can improve their safety work activities.	D.3 Use a teacher prepared "Safety Handout" identifying and describing common safety concerns, hazards, proper procedures, etc., for discussion.
	D.4 Ask a doctor, nurse, or other medical professional (perhaps a Red Cross volunteer) to be a guest lecturer.
	D.5 Have each student list selected safety rules.
E. Identify and describe possible solutions for a selected number of current and future power technology problems.	E.1 Design and construct a scale model of a current power technology system.
Identify and define selected environmental concerns related to power technology.	E.2 Locate numerous selected magazines or newspaper reports relevant to the topics under study - use these for discussion, presentations, etc.

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT I: Introduction to Power Technology

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
	E.3 Have students identify possible power technology safety hazards or problems related to the lab, their home, community or a specific device. After identifying, each student should analyze the situation and provide a an appropriate number of solutions.
F. Be able to identify and properly use all basic tools.	F.1 (See E.3 above)

UNIT II

Basic Power Technology Concepts

OBJECTIVES:

This unit is meant to provide the student with:

1. Information about basic power technology terminology.
2. Information about fundamental energy sources for power.

1.0.0 What is Power?

- 1.1.0 Work
- 1.2.0 Energy
- 1.3.0 Power

2.0.0 Basic Power Theory

- 2.1.0 Resource input
- 2.2.0 Conversion/control
- 2.3.0 Transmission
- 2.4.0 Output/work

3.0.0 Measurement of Power

- 3.1.0 Horsepower
- 3.2.0 Torque
- 3.3.0 Force
- 3.4.0 Watt
- 3.5.0 Pressure
- 3.6.0 R.P.M.
- 3.7.0 B.T.U.
- 3.8.0 Mechanical advantage

4.0.0 Major Sources and Forms of Energy for Power

- 4.1.0 Sun
- 4.2.0 Kinetic and potential energy

4.3.0 Energy forms

4.3.1 Chemical
4.3.2 Heat
4.3.3 Electrical
4.3.4 Mechanical

5.0.0 Basic Forms of Power

5.1.0 Muscle/animal

5.2.0 Water

5.3.0 Air/wind

6.0.0 Modern Forms of Power

6.1.0 Heat engines

6.2.0 Electric power

6.3.0 Nuclear power

6.4.0 Hydropower

6.5.0 Various cells

7.0.0 Other Resources for Power

7.1.0 Wood

7.2.0 Fossil fuels

7.3.0 Tides

7.4.0 Geothermal

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT II: Basic Power Technology Concepts

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Define power and describe power theory.	A-B. Use library reports, teacher lectures, group discussions, films, industrial tours, guest speakers, various types of examinations, text, student presentations.
Analyze power technology devices and situations in terms of inputs, conversions and transmissions, and outputs.	A-C. (1) Disassemble and reassemble a power technology device. (2) Analyze the various inputs, conversions/transmissions, and outputs in the device. (3) Identify and list the various energy sources inputed and converted, transmitted and used for work. (4) Identify the major form of power used in the power technology device. (5) Using appropriate formula calculate selected measurements related to the disassembled device. (6) Identify as many memechanical advantages as possible. (7) Analyze, in general terms, the overall efficiencies of operation.
B. Analyze power technology devices and situations in terms of inputs, conversions and transmissions, and outputs.	B-C. Have each student analyze types, forms and amounts of energy and power consumed and/or converted in their homes.

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Power Technology

UNIT II: Basic Power Technology Concepts

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
	B-C. Have students tour an industry and analyze the various power inputs, conversions-transmissions, and outputs.
C. List and apply various formula for work/power measurement or analysis. List and define selected mechanical advantages.	
D. Describe selected sources of energy for power technology. List selected energy forms involved in power technology.	D-F. Based on surveys of available magazines, newspapers, human views, etc., have students make projections about what will be the primary energy sources and forms, and power forms of the future.
E. List and describe selected forms of power.	E. Have students analyze various power technology circumstances or devices in terms or major energy forms used.
F. List selected possible resource for power.	D-F. Have students conduct a survey in the laboratory, community, etc., to determine the major power sources used.

UNIT III

MACHINES

OBJECTIVES:

This unit is meant to provide student with information about:

1. simple and complex machine, functions and terminology.
2. machine motions, including laws, terms, types and changes.
3. automation as related to machine.

1.0.0 Purposes

- 1.1.0 Transmit
- 1.2.0 Modify
- 1.3.0 Work
  - 1.3.1 Input/output

2.0.0 Functions

- 2.1.0 Increase force
- 2.2.0 Increase distance
- 2.3.0 Change direction

3.0.0 Simple Machines

- 3.1.0 Level
  - 3.1.1 Class one, two, three
  - 3.1.2 Compound
- 3.2.0 Wheel and axle
- 3.3.0 Pulley
- 3.4.0 Inclined plane
- 3.5.0 Screw
- 3.6.0 Compound/complex

4.0.0 Machine Terminology

- 4.1.0 Effort

UNIT III

4.2.0 Resistance

4.3.0 Fulcrum

4.4.0 Load

4.5.0 Mechanical advantage

4.6.0 Efficiency

4.7.0 Friction

5.0.0 Laws of Motion

5.1.0 Inertia

5.2.0 Force/acceleration

5.3.0 Action/reaction

5.4.0 Terms related to motion

5.4.1 Body, velocity, direction, mass, acceleration/deceleration, momentum

6.0.0 Types of Motion

6.1.0 Rotary

6.2.0 Reciprocating

6.3.0 Rectilinear

6.4.0 Oscillatory

6.5.0 Vibratory

7.0.0 Changing Motions

7.1.0 Cranks

7.2.0 Cams

7.3.0 Linkages

8.0.0 Automation

8.1.0 Cycling

8.2.0 Air logic

8.3.0 Hydraulics

8.4.0 Computers

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT III: Machines

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Describe the purposes and functions of machines.	A-G. Use library reports, teacher lectures, group discussions, films, industrial tours, guest speakers, examinations, textbooks, student presentations. Disassemble and reassemble a machine or part of a power technology system. Analyze the machine to determine color needed. (1) The simple machines within the larger machine. (2) The purpose and functions of the machine being analyzed, and purposes and functions of the simple machines. (3) Types of motion and changes in motion which occur in the functioning of the machine. (4) How the machine relates to the concept of automation. Have each student identify a machine in their laboratory, home, school, etc., and analyze it for the same information identified in the previous activity. Have each student conduct an industrial analysis. Have each student determine: (1) Common simple machines used in industry. (2) Common types of automation used.

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT III: Machines

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
	(3) Common types of levers and motion used. (4) In all cases, identify the circumstances of their use and their relationship to the power system in the industry.
B. Identify and define simple machines. Identify and describe the function and application of levers.	(See A-G; above)
C. List and identify selected machine terminology.	(See A-G; above)
D. List, identify and relate to power technology and machines in general, laws and and types of motion, and methods for changing motion.	(See A-G; above)
E. Identify and define selected terms related to motion.	(See A-G; above)
F. Identify and define selected methods of automation.	(See A-G; above)
G. Describe the relationship of machines and automation.	F-G. Have each student conduct an informal survey of the types of tasks that are performed by automated machines in their lives. Have each student identify how their lives might be different if automated machinery were nonexistent.

UNIT IV

Conversion of Power: Heat Engines

OBJECTIVES:

This unit is meant to provide students with:

1. An overview and introduction to conversion of power through heat engines.
2. Heat engine specifics, including types, terms, history, and functioning.

1.0.0 General Concepts

- 1.1.0 History
  - 1.1.1 Watt, Otto, Daimler, and others
- 1.2.0 Heat, heat loss
- 1.3.0 Fuels
- 1.4.0 Laws of thermodynamics
  - 1.4.1 Energy change
  - 1.4.2 Waste
  - 1.4.3 General efficiencies

2.0.0 Heat Engine Terminology

- 2.1.0 Cylinder, block, head, values, crank, rings, connecting rod, flywheel, cam, carburator, cooling, lubrication, compression ratio, etc.

3.0.0 Heat Engine Shapes

- 3.1.0 Inline, V, inverted, flat, radial, bank, multicylinder
- 3.2.0 Valve arrangements
  - 3.2.1 F, L, I, T, reed, sliding

4.0.0 Internal Combustion

- 4.1.0 Timing/ignition/fuel
- 4.2.0 Four cycle
  - 4.2.1 Intake, compression, combustion, exhaust

UNIT IV

4.3.0 Two cycle

4.3.1 Intake and compression, combustion and exhaust

4.4.0 Diesel

4.4.1 Low R.P.M., high torque
4.4.2 Injectors, heat ignition, compression ratio

4.5.0 Rocket

4.5.1 Chemical and other propulsion systems
4.5.2 Solid/liquid fuels
4.5.3 Specific impulse

4.6.0 Jet

4.6.1 Thrust, compression, turbine, tailpipe

4.7.0 Gas turbine

4.7.1 Gassifier, regenerator, compressor, power turbine

4.8.0 Rotary

4.8.1 Epitrochordal shape, eccentric

4.9.0 Applications

4.9.1 Transportation, production, etc.

5.0.0 External Combustion

5.1.0 Steam

5.1.1 Condensers and jackets
5.1.2 Compound
5.1.3 Uniflow
5.1.4 Piston and valving
5.1.5 Reciprocating/oscillating
5.1.6 Applications

5.1.6.1 Turbines, generators, etc.

5.2.0 Stirling

5.2.1 Theory
5.2.2 Characteristics
5.2.3 Applications

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Power Technology

UNIT IV: Conversion of Power: Heat Engines

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Identify and describe selected significant developments in the evolution of heat engines. List and define common heat engine fuels. Describe how the Laws of Thermodynamics, heat, heat loss, and general efficiencies related to heat engine functioning.	A-E. Use library reports, teacher lectures and demonstrations, group discussions, films, industrial tours, guest speakers, examinations, textbooks, student presentations and laboratory activities. A.1 Locate and rebuild an antique heat engine. A.2 Chart the lineage/historical development of a type of heat engine. A.3 Visit a museum displaying heat engines no longer in common use. A.4 Visit a petroleum refinery. A.5 Visit a gasoline station or bulk plant and conduct an interview with management about type of fuels. A.6 Conduct an interview with an individual sixty years or older, discussing heat engines of days-gone-by. A.7 Participate individually, or in a group, in the disassembly of a small gasoline engine which was damaged by overheating. (1) Analyze damaged areas and relate to heat, heat loss, waste,

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT IV: Conversion of Power: Heat Engines

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
	energy change, general efficiencies and thermodynamics. (2) Determine how long a small gasoline engine will run under no load on a predetermined small quantity of fuel with proper cooling at a determined R.P.M. With an equivalent quantity of fuel, remove the cooling shroud and compare the running times achieved under the two different situations.
	A.8 Have students conduct a comparison of the various heat engines regarding thermodynamics using, the fundamental question, "Why are the various engines used the ways they are?"
B. Identify, list and define common components in heat engines, and relate them to the overall functioning and principles of heat engines.	B.1 Have each student disassemble and reassemble an engine. While disassembled have each student or group, (1) Identify all components diagraming and labeling these on a separate sheet of paper. (2) Identify its shape and valve arrangement and why it is designed that way. (3) Identify and chart the combustion process for the unit being studied. (4) Note differences of this unit when compared to other internal and external heat engine units. (5) Identify and describe various applications for the engine being studied.

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Power Technology

UNIT IV: Conversion of Power: Heat Engines

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
	B.2 Have students conduct an informal survey of a selected number of various types of power technology devices using heat engines, in their school, community, home etc. Have each student: (1) Determine which type of engine was used the most. (2) Describe its components, and general functioning. (3) Determine why this type of engine was found useful. (4) Identify possible modifications which could be performed on this type of engine to increase its overall efficiencies.
C. Identify and describe selected heat engine shapes and cylinder and valve arrangements.	C.1 (See A-B above)
D. Describe the internal combustion process. Describe and identify two and four cycle combustion systems, relating their functioning to internal combustion systems.	D.1 (See A-B above)

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT IV: Conversion of Power: Heat Engines

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
Identify and describe the differences and similarities in diesel, rocket, jet, turbine, and rotary engines, noting the major components and unique characteristics of each, and how each qualifies as an internal combustion heat engine.	
Identify and describe selected applications for internal combustion engines.	
E. Identify and describe characteristics of external combustion engines, citing major components, and similarities and differences when compared to internal combustion heat engines.	E.1 (See A-B above)
Identify and describe selected applications for external combustion engines.	

UNIT V

Electrical Conversion of Power

OBJECTIVES:

This unit is meant to provide students with information about:

1. Fundamentals of electricity.
2. Electrical conversion of power, including terminology, types conversions, applications, etc.

1.0.0 The Nature of Electricity

- 1.1.0 Major developments
  - 1.1.1 Franklin, Galvani, Volta, Edison
  - 1.1.2 Dry cells, storage batteries, motors, generators
- 1.2.0 Where does electricity come from?
  - 1.2.1 Composition of matter
  - 1.2.2 Frictional electron imbalance
  - 1.2.3 Electrostatic charges
  - 1.2.4 Conducting/resisting electron flow
  - 1.2.5 Chemical to electrical energy conversion
  - 1.2.6 Primary/storage cells

2.0.0 Units of Electrical Energy

- 2.1.0 Voltage
- 2.2.0 Current
- 2.3.0 Power
- 2.4.0 Resistance/conductance
- 2.5.0 Ohm's Law

3.0.0 Circuits

- 3.1.0 Parallel
- 3.2.0 Series

4.0.0 Types of Current

- 4.1.0

4.2.0 Direct

5.0.0 Magnetism

5.1.0 Properties and types of magnetism

5.1.1 Natural, permanent, electromagnetism
5.1.2 Magnetic atomic structure

5.2.0 Principles of magnetism

5.2.1 Attraction/repulsion
5.2.2 Lines of force
5.2.3 Magnetic flux/field
5.2.4 Magnetomotive force

6.0.0 D.C. Motors and Generators

6.1.0 Armature, field, comutator, brushes

6.2.0 Series/shunt wound, compound motors

7.0.0 A.C. Motors and Generators

7.1.0 Generators/alternators

7.1.1 Revolving-field, sine wave, phase, reactance
7.1.2 Field poles, rotors, stators, exciter, armature, field coils

7.2.0 Motors

7.2.1 Universal, induction and synchronons

8.0.0 Transformers

8.1.0 Primary and secondary windings

8.2.0 Air cores, iron cores

9.0.0 Applications of AC and DC Electricity

10.0.0 Direct Conversion of Electricity

10.1.0 Magnetohydrodynamic generators, fuel cells, photovoltaic converters, thermionic converters, and thermoelectric converters

11.0.0 Nuclear Conversion

11.1.0 Atomic theory

UNIT V

11.2.0 Fission versus fusion

11.3.0 Nuclear fuels

11.4.0 Reactor operation

11.5.0 Environmental concerns

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT V: Electrical Conversion of Power

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. List and describe selected significant developments and leaders in the evolution of electricity. Describe the physical and atomical composition and functioning of electricity. Identify and describe the conductance of, and resistance to, electron flow. Identify describe and differentiate between primary and storage cells.	A-J Use library reports, teacher lectures, demonstrations, group discussions, films, industrial tours, guest speakers, examinations of various sorts, textbooks, and student presentations. Have students (groups or individuals) analyze an industrial machine or process to determine its general functioning, inputs/-conversions and transmissions/outputs, with reference to electricity. Diagrams and nomenclature should be included. A drill press, tabie saw, lathe, welder, etc., in the laboratory and simply related to the industrial reality. A-D Have students: (1) Use a V.O.M. to measure and determine conductance of/and resistance to electricity in various circuits. (2) Calculate various empirical values in the circuits using Ohm's Law. (3) Change the circuit from parallel to series (or vice versa) and re-calculate values. (4) Analyze why parallel

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT V: Electrical Conversion of Power

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	and series circuits are used and how this relates to A.C. or D.C. theory and applications. (5) Discuss general efficiencies related to A.C. or D.C. circuits. (6) Identify various applications of circuits and applications in their environment and explain why they are used these ways. A.1 Have each student chart the evolution/lineage of an electricity development, identify and tracing all significant developments leading up to the development under study. A.2 Have each student locate an antique power technology device related to electricity and rebuild/refurbish the device, comparing it to modern-day devices for changes and modifications. A.3 Have each student use atomic structure models (perhaps borrowed from the physics/science/chemistry teachers) to construct how materials: (1) Hold together. (2) Constitute

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT V: Electrical Conversion of Power

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
	charges. (3) Conduct or resist electron flow. If a model cannot be purchased or borrowed, have the students make one.
	A.4 Have students dissect/take apart a primary cell and a storage cell, comparing the two in terms of their structure and functioning.
B. Identify, describe and measure basic units of electrical energy.	(See A-J.1)
C. Identify, describe and measure parallel and series circuits characteristics.	(See A-J.1)
D. Identify and describe alternating and direct current characteristics.	(See A-J.1)
E. Identify and describe types and properties of magnetism and relate these to power technology.	(See A-J.1)
	E.1 Have students dissect/disassemble and analyze a solenoid from an automobile starter, explaining: (1) Its functioning. (2) Its possible applications beyond automobiles e.g. automation, industry machinery, etc. (3) Why it might be used in many power technology

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT V: Electrical Conversion of Power

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
	applications as opposed to a pneumatic/hydraulic/heat engine converter device to accomplish a similar task. (4) Compare how electromagnetism in the solenoid is similar to or different from natural and permanent magnetism.
F. Identify and describe the functioning, and be able to apply the principles in analysis situations, of A.C. and D.C. motors and generators.	F.1 Have students disassemble and reassemble A.C. and D.C. motors and generators of various types. Have each student determine: (1) Motor/generator type. (2) How each functions. (3) Why they are structured and designed as they are. (4) How they are similar and different. Also have each student diagram and label each device they are disassembling/reassembling. The students should have appropriate manuals and text materials available for their use. Have each student recondition an A.C. or D.C. motor or generator.

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT V: Electrical Conversion of Power

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
G. Identify and describe the functioning of common transformers.	G.1 Have each student (or group locate a discarded coil/ transformer and dissect/ disassemble the unit, identifying: (1) How it functions. (2) Why it functions. (3) Various applications.
H. Identify and describe selected applications of A.C. and D.C. electricity.	H.1 Have students conduct an informal survey of their environment to determine various applications for A.C. and D.C. electricity.
	H.2 Have students construct a bicycle-generator unit to power a variety of light bulb circuit capabilities. This should assist students in understanding amount of power needed to create and convert electricity. Also, student could easily apply Ohm's Law to this situation to determine empirical values of power. Discussion could also be focused on types of conversion, their usefulness, etc.
I. Identify and describe selected direct conversion devices and principles of electricity.	I.1 Have students look through magazines, newspapers or other information related to direct conversions of electricity. Particular attention should be focused on the future of these conversions.

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT V: Electrical Conversion of Power

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
J. Identify and describe selected characteristics related to nuclear power.	J.1 Have students locate news stories related to nuclear power. It might also be useful to have students conduct a survey of local community views related to nuclear power.

UNIT VI

Mechanical Transmission of Power

OBJECTIVES:

This unit is meant to provide the student with information about:

1. Various mechanical transmission devices.
2. Common mechanical theory regarding transmission systems.
3. Specific applications related to mechanical transmission of power.

1.0.0 Indirect Linkages

- 1.1.0 Chain and sprocket
- 1.2.0 Chains
  - 1.2.1 Bush, leaf, flat top, conveyor, roller
- 1.3.0 Belt and pulley
  - 1.3.1 Driving, driven, idler
  - 1.3.2 Flat, ribbed, double-angle V, banded V, narrow, steel cable, glass cord, connected link
  - 1.3.3 Tension, belt wrap, optimum speed, material flexing
- 1.4.0 Cams
  - 1.4.1 Drum or barrel, edge, face, yoke, heart, toe and wiper, mushroom contoured face, cloverleaf
- 1.5.0 Levers
- 1.6.0 Screws
- 1.7.0 Wheel and axle
- 1.8.0 Rods and shafts
- 1.9.0 Gears
  - 1.9.1 Pinion, spur, helical, herringbone, bevel, hypoid, external/internal, ratios

UNIT VI

2.0.0 Direct Connection

2.1.0 Couplings

2.1.1 Rigid

2.1.1.1 Sleeve/flanged

2.1.2 Flexible couplings

2.1.2.1 Resilient material, mechanical flexible, combinations

2.1.3 Shaft couplings

2.1.3.1 Floating, spline, universal joint, set screws, keyway, brake drum, torque limiting

3.0.0 Bearings

3.1.0 Sleeve, journal, anti-friction

3.2.0 Insert, roller, ball, thrust

3.3.0 Housings

3.3.1 Pillow blocks, flanged blocks, flanged cartridge, cartridge units

4.0.0 Friction

4.1.0 Causes

4.1.1 Intermeshing irregularities, adhesion due to molecular attraction, indentation due to hard/soft materials and pressures

4.1.2 Static, sliding, rolling

5.0.0 Lubrication

5.1.0 Grease

5.1.1 Chemically inactive, even consistency, high melting point, free of abrasive contaminants

5.2.0 Oils

5.2.1 Sealing, cooling, cleaning, lubrication

5.2.2 Petroleum, animal fats, vegetable oils, silicones

5.2.3 Detergents, inhibitors, dispersives

5.2.4 Splash, force pumping

5.2.5 Filtering

6.0.0 Maintenance

6.1.0 Troubleshooting, inspection, routine checking and testing, replacement of defective or worn parts, tune-up

6.2.0 Servicing

6.2.1 Be organized
6.2.2 Follow service procedures
6.2.3 Use the manual
6.2.4 Know when to get an expert

6.3.0 Problem signs

6.3.1 Worn parts, noises, oil use and leaks, loose parts, excessive power consumption/loss

7.0.0 Mechanical Applications

7.1.0 Brakes

7.1.1 Band, block, drum, drum brake, disc

7.2.0 Clutches

7.2.1 Friction, magnetic, overload, dry, fluid, idler, centrifugal

7.3.0 Variable speed drives

7.3.1 Mechanical, hydraulic, electrical

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT VI: Mechanical Transmission of Power

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Identify and describe selected types of indirect linkage components. Identify and describe the relationships and applications of indirect linkage components in various power technology mechanisms and systems.	A-G Use library reports, teacher lectures, and demonstrations, group discussions, films, industrial tours, guest speakers, examinations of various types, textbooks, student presentations. Using teacher prepared components representing each of the categories identified, have students disassemble each item. While disassembled, the item labeled, and perhaps analyzed for wear, proper or inproper maintenance procedures, and reasons why is/are no longer being used. The item should be studied in terms of its possible/actual mechanical power systems applications and also studied in terms of its differences and similarities to other types of components. Suggested components to be organized for students might include cams, levers, chains and sprockets, pulleys and belts, screw shafts, wheel/axle combinations, gears, etc.

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT VI: Mechanical Transmission of Power

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	Similar to the previous strategy the instructor should locate appropriate mechanical power technology devices or systems such as actual transmissions, gear drives, cycling (cams/eccentrics) devices (like the timer on a washing machine), pulley/belt devices, differentials, pumps, etc. Students should assemble/disassemble the devices for analysis work. Questions to be addressed by the students include: (1) How does the device work? (2) What indirect/direct connection components, bearings, housings, and lubricants were used? (3) What were the relationships of the items identified (requiries diagraming/labeling and the use of manuals/text materials)? (4) What were the maintenance procedures for the system? (5) What were the worn/damages areas in the system? (6) What applications might be (were) appropriate for the device/system? (7) How might the device be improved? Involve student in producing cutaway models of actual transmission devices, which can be particularly useful for other later students.

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Power Technology

UNIT VI: Mechanical Transmission of Power

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
	These models should remain somewhat functional so that inter-relationships can be more easily studied and learned. Have students recondition a mechanical power technology device. Proper manuals, procedures, service techniques, etc., should be observed and employed.
B. Identify and describe selected types of direct connection mechanical transmission components.	B.1 (See A-G; above)
C. Identify and describe selected types of bearings, and their housings where applicable.	C.1 (See A-G; above)
D. Identify and describe selected results of friction and the causes.	D.1 (See A-G; above)
E. Identify selected types of lubricants and their functions.	E.1 (See A-G; above)
F. List and define selected maintenance, servicing and problem solving procedures related to mechanical power systems.	F.1 (See A-G; above)
G. Identify and describe common mechanical power technology applications and circumstances.	G.1 (See A-G; above)

UNIT VII

Fluid Power

OBJECTIVES:

This unit is meant to provide students with information about:

1. Fluid power systems, including principles, types, components and operation.

2. Water power, hydraulic power, and pneumatic power.

1.0.0 Water Power

1.1.1 Turbines

1.1.1.1 Undershot, overshot water wheels
1.1.1.2 Waterflow and waterheld
1.1.1.3 Measuring water power
1.1.1.4 Impulse, reaction and propeller
1.1.1.5 Hydrostorage

2.0.0 Principles of Fluid Power

2.1.0 Theory

2.1.1 Pascal's, Boyle's, Charles's, laws and Bernoulli's principle.

2.2.0 Compression of fluids

2.3.0 Transmission of power through liquids and gases

2.4.0 Fluid head pressure

2.5.0 Measurements

2.6.0 Mechanical advantage

3.0.0 Hydraulics and Pneumatics

3.1.0 Fluid power inputs

3.1.1 Compressors, accumulators, oil, air, filters, condensers, reservoirs, pumps

3.2.0 Fluid power controls

3.2.1 Flow, pressure and directional control valves
3.2.2 Check and relief valves
3.2.3 Transmission lines, circuits and tubes

UNIT VII

Fluid Power

3.3.0 Power outputs

3.3.1 Cylinders, motors, suspension devices

4.0.0 Applications of Fluid Power

4.1.0 Jacks, brakes, clutches, automatic transmissions, aircraft applications, lifts, automatic doors, etc.

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT VII: Fluid Power

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Identify and describe selected information pertaining to water power.	A.1 Use library reports, teacher lecture/demonstrations, group discussions, films, industrial tours, guest speakers, examinations of various types, textbooks, student presentations.
	A.2 Have students visit a hydro-power plant site. (Analyzing, diagraming, etc.) to identify the various components, functioning, etc.
	A.3 Construct a scale model of a hydro-power plant, addressing similar concerns identified above.
B. Identify, describe and relate the theory of fluid power to actual fluid power circumstances.	B.1 (See A.2 above)
	B.2 Give students problems to solve related to fluid mechanisms. For example - have them calculate input power needed and determine the components, controls, and output hardware to mechanically drive a drill press spindel, lathe carriage, floor jack, etc. Also, many textbooks mentioned in the Reference Section offer problems.
	B.3 Have each student locate a fluid power device with a functional problem. Require each student to solve the problem, perhaps reconditioning the device, or accomplishing whatever may be needed to permit proper function.

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT VII: Fluid Power

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
C. Identify, describe and put into actual use selected input, control, and output components for fluid power technology.	C.1 Have the student disassemble/ reassemble various hydraulic and pneumatic power technology devices. Questions similar to those previously addressed can be used with reference to fluidics. Empirical formulas can be employed to determine amounts of pressure needed, size of pump, etc., for units under study.
	C.2 Have students design and fabricate a fluid mechanism capable of accomplishing a task in the laboratory or one of their choosing.
D. Identify and describe common application for fluid power technology.	D.1 Have students survey common applications of fluid power in their environment. How they are used, why they are used, and how else they might be used.
	D.2 (See B.3)

UNIT VIII

Research and Development

)BJECTIVES:

This unit is meant to provide students with information about:

1. Recent power technology research and de elopment innovations.
2. Research and development as an individual method.

1.0.0 What is Research and Development?

- 1.1.0 Pure research
- 1.2.0 Applied research
- 1.3.0 Seeking answers to problems
- 1.4.0 Finding new ways to provide power technology

2.0.0 The Scientific Method for Problem Solving

- 2.1.0 Identify a problem
- 2.2.0 Gather information
- 2.3.0 Preliminary analysis/design
- 2.4.0 Testing the approach/design
- 2.5.0 Further analysis
- 2.6.0 Finalizing the approach/design

3.0.0 Testing the Prototype

- 3.1.0 Destructive
- 3.2.0 Non-Destructive

4.0.0 What Needs Research and/or Development?

- 4.1.0 Operation
- 4.2.0 Applications
- 4.3.0 Efficiency
- 4.4.0 Heat engines

4.4.1 Rankine, Brayton, Sterling, Wankel, Diesel, others

4.5.0 Cells

4.5.1 Oxygen-concentration, hydrox, redox, hydrogen, ion-exchange, solar, others

4.6.0 Converters

4.6.1 Thermophotovoltaic, thermoelectric, thermionic, others

4.7.0 Generators

4.7.1 Hydron, magnetohydrodynamic, others

4.8.0 Conventional Power Technology

4.8.1 Hydraulics, pneumatics, electrical, others

4.8.2 Sources

4.8.2.1 Petroleum, coal, natural gas, nuclear, others

4.9.0 Other Future Power Technology

4.9.1 Steam, water, wind, electric vehicles, solar, coal gasification, others

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Power Technology

UNIT VIII: Research and Development

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Identify and describe research and development.	A.1 Use library reports, teacher lecture and demonstrations, group discussion, films, industrial tours, guest speakers, examinations of various types, textbooks, student presentations and demonstrations.
	A.2 Have each student or group identify a problem needing solution or research, and/or development. (1) Have students use the scientific method and the design process to address the problem; (2) Build a model of the solution; (3) Build an actual full scale, functional solution to the problem.
	A.3 Have students identify and discuss areas/problems which have been solved through application of research and development, the scientific method, and the design process in the past.
	A.4 Using news media, library material, community surveys, etc., have students determine possible areas needing research and development and have students design/plan a solution to the problem.

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Power Technology

UNIT VIII: Research and Development

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
B. List and describe the scientific method and design process as related to research and development.	B.1 (See A.3)
C. Identify selected types of prototype testing.	C.1 (See A.1 - A.4)
D. List and describe selected current items/areas needing to be researched and/or developed.	D.1 (See A.1 - A.4)
E. Identify and describe future power technology needing to be researched and developed.	E.1 (See A.4)

UNIT IX

Careers in Power Technology

OBJECTIVES:

This unit is meant to provide the student with:

1. An orientation and awareness of career opportunities related to power technology.
2. The structure of industry in power technology careers.

1.0.0 General Occupational Information

- 1.1.0 Educational requirements
  - 1.1.1 Type of training
    - 1.1.1.1 College
    - 1.1.1.2 Trade school
    - 1.1.1.3 On-the-job
    - 1.1.1.4 Apprenticeship
- 1.2.0 Placement
- 1.3.0 Types of jobs
- 1.4.0 Salary ranges
- 1.5.0 Opportunities for advancement

2.0.0 Professional

- 2.1.0 Engineer/designer
- 2.2.0 Inventor
- 2.3.0 Researcher/scientist
- 2.4.0 Educators
- 2.5.0 Executives/management

3.0.0 Technical

- 3.1.0 Quality/production supervisor
- 3.2.0 Engineering assistant
- 3.3.0 Drafting/design personnel
- 3.4.0 Experimental personnel/technicians

UNIT IX

Careers in Power Technology

4.0.0 Skilled

- 4.1.0 Electrician
- 4.2.0 Mechanic
- 4.3.0 Assembler
- 4.4.0 Machinist
- 4.5.0 Technicians

5.0.0 Semi-Skilled

- 5.1.0 On the job trainees
- 5.2.0 Self improved workers

6.0.0 Non-Skilled

- 6.1.0 Helpers
- 6.2.0 Laborers
- 6.3.0 Attendants

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Power Technology

UNIT IX: Careers in Power Technology

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Identify and describe selected general ocupational information related to power technology.	A.1 Use library reports, teacher lectures and demonstrations, films, industrial tours, guest speakers, examinations of various types, textbooks, student presentations. A.2 Have students conduct an interview with an individual employed in a power technology career or related field. Students should seek answers to questions such as: (1) What are their responsibilities; (2) What was their training; (3) Starting salary ranges; (4) Opportunities for advancement; and perhaps others. Have each student present their findings to the rest of the class. A.3 Have students conduct a general survey in their community to identify all career opportunities related to power technology. When identified, they should seek answers to questions similar to those previously identified.
B. Identify and describe selected information related to professional, technical, skilled, semi-skilled and non-skilled careers in power technology.	B.1 (See A.1 - A.3)

REFERENCES

1. Walker, John R. Exploring Power Technology. The Goodheart-Willcox Co., South Holland, Illinois 1976.

Selected References:

1. Bohn and McDonald. Power: Mechanics of Energy Control. McKnight Publishers, Bloomington, Illinois 1970.

2. Doolittle, Jesse S. Energy: A Crisis, A Dilema or Just Another Problem? Matrix Publishing, Champaign, Illinois 1977.

3. Duffy, Joseph W. Power: Prime Mover of Technology. McKnight Publishers, Bloomington, Illinois 1972.

4. Geil, John J. Energy and Transportation: Power. Prentice-Hall, Inc., Englewood Cliffs, N.J. 1976.

5. Glen, Harold T. Exploring Power Mechanics. Bennett Publishing Co., Peoria, Illinois 1974.

6. Grannis, Gary E. Modern Power Mechanics. Bobbs-Merrill, Indianapolis, Indiana 1979.

7. Miller and Bohn. Power Mechanics. McKnight Publishers, Bloomington, Illinois 1978.

8. Stephenson, George E. Power Technology. Delmar Publishers, New York, New York 1973.

Periodicals:

1. Popular Mechanics

2. Mechanics Illustrated

3. Popular Science

Films:

1. Shell Oil Company. 1433 Sadler Circle, Indianapolis, Indiana 46239. Shell offers several power technology related films for viewing; free.

2. Fuel and Energy Office. Capital Building, Bismarck, North Dakota 58501. This office has numerous teaching aids, films, speakers, etc., most of which are free or inexpensive.

3. The Department of Energy Technical Information Center, Oak Ridge, Tennessee will provide, free of charge, energy and power activities for classroom purposes.

4. Local utility companies frequently have information films, activities, tours, resource people, etc., available, most of which are related to power technology.